**Citation:**

English DR, MacInnis RJ, Hodge AM, Hopper JL, Haydon AM, Giles GG. Red meat, chicken, and fish consumption and risk of colorectal cancer. Cancer Epidemiol Biomarkers Prev. 2004;13(9):1509-14.

**PubMed ID:** 15342453

**Study Design:**

Prospective Cohort Study

**Class:**

B - Click here for explanation of classification scheme.

**Research Design and Implementation Rating:**

POSITIVE: See Research Design and Implementation Criteria Checklist below.

**Research Purpose:**

The purpose of this prospective study was to investigate the relationship between red meat, chicken and fish consumption and the risk of colorectal cancer.

**Inclusion Criteria:**

The Melbourne Collaborative Cohort Study included:

- residents of Melbourne, Australia
- ages 27 - 75 years at baseline
- Italian and Greek immigrants were deliberately recruited.

**Exclusion Criteria:**

Participants were excluded if:

- they had colorectal cancer, diabetes, a heart attack, or angina before baseline.
- had no dietary data; or their reported energy intake was in the lowest or highest 1% of the sex-specific distributions.

**Description of Study Protocol:**

**Recruitment**

Subjects were recruited via the electoral rolls (registration to vote is compulsory in Australia), advertisements, and community announcements in local media. Comprehensive lists of Italian and Greek surnames were also used to target southern European migrants in the phone book and the Electoral rolls.

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**Design**

Diet was measured in a cohort of subjects. Incidence of colorectal cancers was ascertained from the same group.

**Statistical Analysis**

Cox's proportional hazard model, with age as the time metric, was used to estimate rate ratios, 95% confidence intervals (95% CI), and *P*s.Calculation of person-time began at baseline and eded at the earliest of the date of diagnosis of colorectal cancer, date of diagnosis of cancer of unknown primary site, date of death, date last known to be in Victoria, or June 30, 2002. Tests based on Schoenfeld residuals and graphical methods using Kaplan-Meier curves showed no evidence that any proportional hazard assumptions were violated for any analyses.

All meat consumption variables were analyzed as categorical, based on approximat equartiles of the distribution of weekly frequency of consumption, and a pseudo-continuous, assuming that, within each quarter, all subjects consumed at the median frequency. *P*s for trend were calculated for all variables.

Sex, country of birth and energy intake were included in all models. Other potential confounding variables were included in all the definitive analysis if they changed the hazard ratios of any of the meat consumption variables for either colon or rectal cancer by at least 5%.

Polytomous logistric regression models, adjusting for age, sex, country of birth, and consumption of energy fat, and cereal products were used to test for homogeneity in odds ratios of the pseudo-continuous meat consumption variables for colon versus rectal cancer, proximal distal colon cancer and early vs late state disease.

**Data Collection Summary:**

**Timing of Measurements**

Baseline between 1990-1994; End of follow-up June 30, 2002 (average of 9 years per subject).

**Dependent Variables**

- Cancer ascertainment: identified from notifications to the Victorian Cancer Registry of diagnoses of adenocarcinoma of the colon and rectum.

**Independent Variables**

- Dietary assessment: dietary questionnaire including a food frequency questionnaire. Nutrient intakes were calculated using mean sex-specific portion sizes and weighed food records.
    - fresh red meat
    - processed meat
    - chichen
    - fish

**Control Variables**

- Other risk factors: a structured interview schedule was used to obtain information on potential risk factors including age, sex, country of birth, alcohol consumption, current physical activity during leisure time, education and use of hormone replacement therapy.

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- Height, weight, and waist and hip circumference were measured.

**Description of Actual Data Sample:**

**Initial N**: 41,528 (17,049 men)

**Attrition (final N):** 37,112

**Demographic characteristics in the Melbourne Collaborative Cohort**

| **Baseline age, y** | |
|---|---|
| <50 | 12,633 |
| 50-59 | 12,252 |
| 60+ | 12,227 |
| **Sex** | |
| Male | 14,643 |
| Female | 22,469 |
| **Country of birth** | |
| Australia and other | 28,649 |
| Greece | 3,841 |
| Italy | 4,622 |
| **Education** | |
| Primary school | 6,713 |
| Some high school | 14,184 |
| Completed high school | 7,718 |
| Degree/diploma | 8,497 |

**Summary of Results:**

**Key Findings**

- Over an average of 9 years of follow-up, a total of 451 subjects with incident colorectal cancer (97% were histologically verified) were identified, including 283 colon tumors (147 proximal, 111 distal, and 25 that could notbe classified) and 169 rectal tumors (one subject had a colon and rectal tumor).
- Increased frequency of fresh red meat consumption was associated with moderately increased risks of rectal cancer but had little association with risk of colon cancer.
- Increased frequency of chicken consumption was weakly associated with decreased risk of

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colorectal cancer.

- Frequency of fish consumption was not association with either colon or rectal cancer.
- For rectal cancer, the hazards ratios (HR) in the highest quartile of consumption of fresh meat processed meat were 2.3 (95% CI: 1.2, 4.2; P for trend =0.07 and 2.0 (95% CI: 1.1, 3.4; P for trend = 0.09), respectively.
- The corresponding HRs for colon cancer were 1.1 (0.7-1.6; P for trend = 0.9) and 1.3 (0.9-1.9; P for trend = 0.06). Chicken consumption was weakly negatively associated with colorectal cancer (HR for high quartile = .7; 95% CI: 0.6, 1.0; P for trend = 0.03), whereas hazard ratios for fish consumption were close to unity.

**Author Conclusion:**

Frequent consumption of fresh red meat and processed meat seemed to be associated with an increased risk of rectal cancer. Consumption of chicken and fish did not increase risk.

***Reviewer Comments:***

*The analyses did not adjust family history of CRC or multiple comparisons.*

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***Research Design and Implementation Criteria Checklist: Primary Research***

**Relevance Questions**

| | | |
|---|---|---|
| 1. | Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies) | Yes |
| 2. | Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about? | Yes |
| 3. | Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice? | Yes |
| 4. | Is the intervention or procedure feasible? (NA for some epidemiological studies) | Yes |

**Validity Questions**

| | | |
|---|---|---|
| **1.** | **Was the research question clearly stated?** | Yes |
| 1.1. | Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified? | Yes |
| 1.2. | Was (were) the outcome(s) [dependent variable(s)] clearly indicated? | Yes |
| 1.3. | Were the target population and setting specified? | Yes |

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| | | |
|---|---|---|
| **2.** | **Was the selection of study subjects/patients free from bias?** | Yes |
| 2.1. | Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study? | Yes |
| 2.2. | Were criteria applied equally to all study groups? | Yes |
| 2.3. | Were health, demographics, and other characteristics of subjects described? | Yes |
| 2.4. | Were the subjects/patients a representative sample of the relevant population? | Yes |
| **3.** | **Were study groups comparable?** | Yes |
| 3.1. | Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT) | N/A |
| 3.2. | Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline? | N/A |
| 3.3. | Were concurrent controls used? (Concurrent preferred over historical controls.) | N/A |
| 3.4. | If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis? | Yes |
| 3.5. | If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.) | N/A |
| 3.6. | If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")? | N/A |
| **4.** | **Was method of handling withdrawals described?** | Yes |
| 4.1. | Were follow-up methods described and the same for all groups? | N/A |
| 4.2. | Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.) | Yes |
| 4.3. | Were all enrolled subjects/patients (in the original sample) accounted for? | Yes |
| 4.4. | Were reasons for withdrawals similar across groups? | N/A |
| 4.5. | If diagnostic test, was decision to perform reference test not dependent on results of test under study? | N/A |
| **5.** | **Was blinding used to prevent introduction of bias?** | Yes |

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| | | |
|---|---|---|
| 5.1. | In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate? | N/A |
| 5.2. | Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.) | N/A |
| 5.3. | In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded? | Yes |
| 5.4. | In case control study, was case definition explicit and case ascertainment not influenced by exposure status? | N/A |
| 5.5. | In diagnostic study, were test results blinded to patient history and other test results? | N/A |
| **6.** | **Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?** | N/A |
| 6.1. | In RCT or other intervention trial, were protocols described for all regimens studied? | N/A |
| 6.2. | In observational study, were interventions, study settings, and clinicians/provider described? | N/A |
| 6.3. | Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect? | N/A |
| 6.4. | Was the amount of exposure and, if relevant, subject/patient compliance measured? | N/A |
| 6.5. | Were co-interventions (e.g., ancillary treatments, other therapies) described? | N/A |
| 6.6. | Were extra or unplanned treatments described? | N/A |
| 6.7. | Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups? | N/A |
| 6.8. | In diagnostic study, were details of test administration and replication sufficient? | N/A |
| **7.** | **Were outcomes clearly defined and the measurements valid and reliable?** | Yes |
| 7.1. | Were primary and secondary endpoints described and relevant to the question? | Yes |
| 7.2. | Were nutrition measures appropriate to question and outcomes of concern? | Yes |
| 7.3. | Was the period of follow-up long enough for important outcome(s) to occur? | Yes |
| 7.4. | Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures? | Yes |
| 7.5. | Was the measurement of effect at an appropriate level of precision? | Yes |
| 7.6. | Were other factors accounted for (measured) that could affect outcomes? | Yes |

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| | | | |
|---|---|---|---|
| | 7.7. | Were the measurements conducted consistently across groups? | Yes |
| **8.** | **Was the statistical analysis appropriate for the study design and type of outcome indicators?** | | Yes |
| | 8.1. | Were statistical analyses adequately described and the results reported appropriately? | Yes |
| | 8.2. | Were correct statistical tests used and assumptions of test not violated? | Yes |
| | 8.3. | Were statistics reported with levels of significance and/or confidence intervals? | Yes |
| | 8.4. | Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)? | N/A |
| | 8.5. | Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)? | Yes |
| | 8.6. | Was clinical significance as well as statistical significance reported? | Yes |
| | 8.7. | If negative findings, was a power calculation reported to address type 2 error? | Yes |
| **9.** | **Are conclusions supported by results with biases and limitations taken into consideration?** | | Yes |
| | 9.1. | Is there a discussion of findings? | Yes |
| | 9.2. | Are biases and study limitations identified and discussed? | Yes |
| **10.** | **Is bias due to study's funding or sponsorship unlikely?** | | Yes |
| | 10.1. | Were sources of funding and investigators' affiliations described? | Yes |
| | 10.2. | Was the study free from apparent conflict of interest? | Yes |

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